short version

Volcanic Ash Cloud Observations with the DLR-Falcon over Europe during Air Space Closure

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+ many partners (IPA, FB, LaMP, TU Darmstadt, IfT Leipzig, LMU München, NILU, Uni. Iceland, DWD, VAAC, DFS, LBA, etc.)

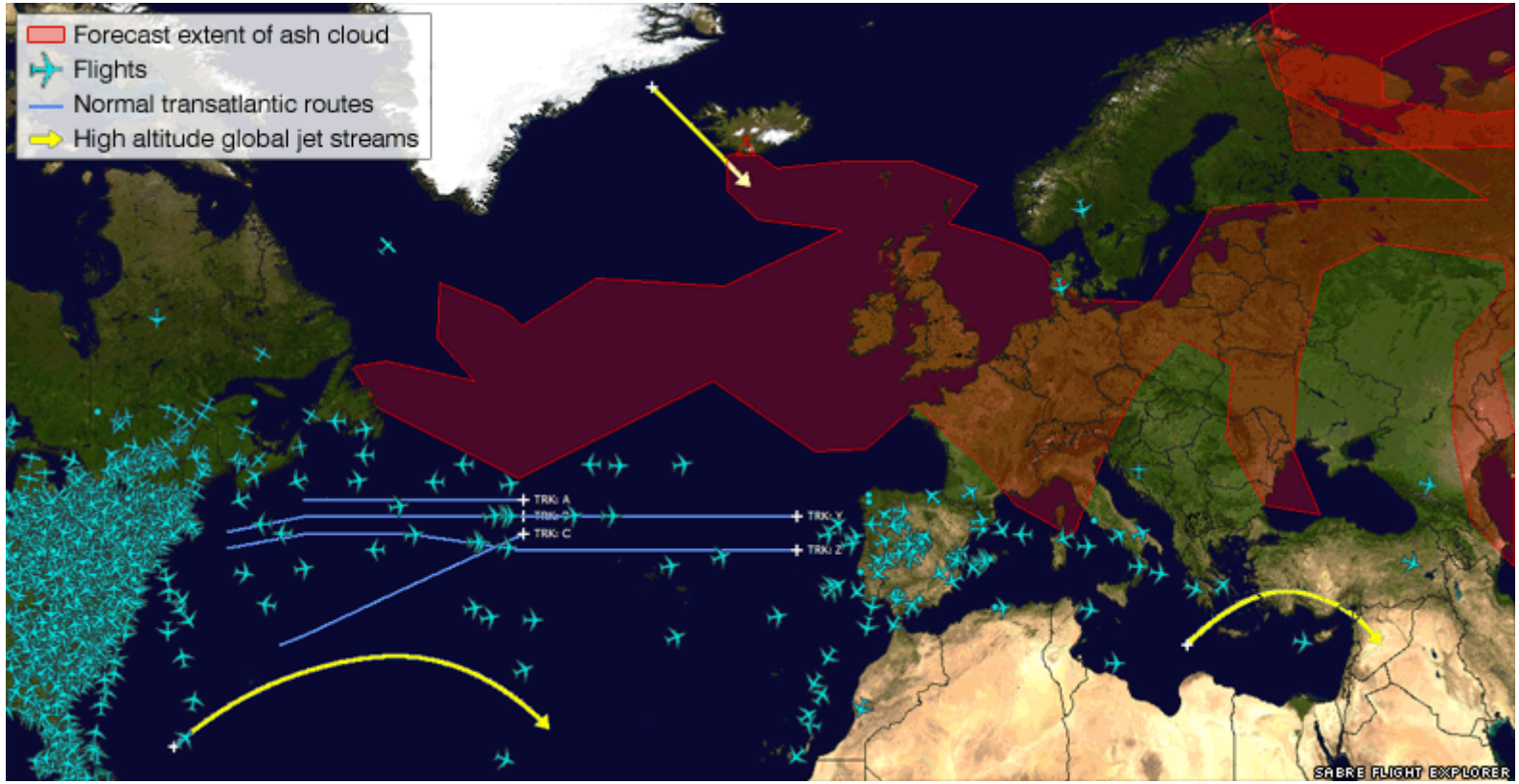
Deutsches Zentrum für Luft- und Raumfahrt e.V. in der Helmholtz-Gemeinschaft

Institut für Physik der Atmosphäre
in cooperation with Ludwig-Maximilians University Munich

100 JAHRE Luft- und Raumfahrtforschung in Deutschland

19 April, 13:00 UTC - Mid-European airspace closed

DLR-Falcon started at 14:11 UTC



http://www.radarvirtuel.com/

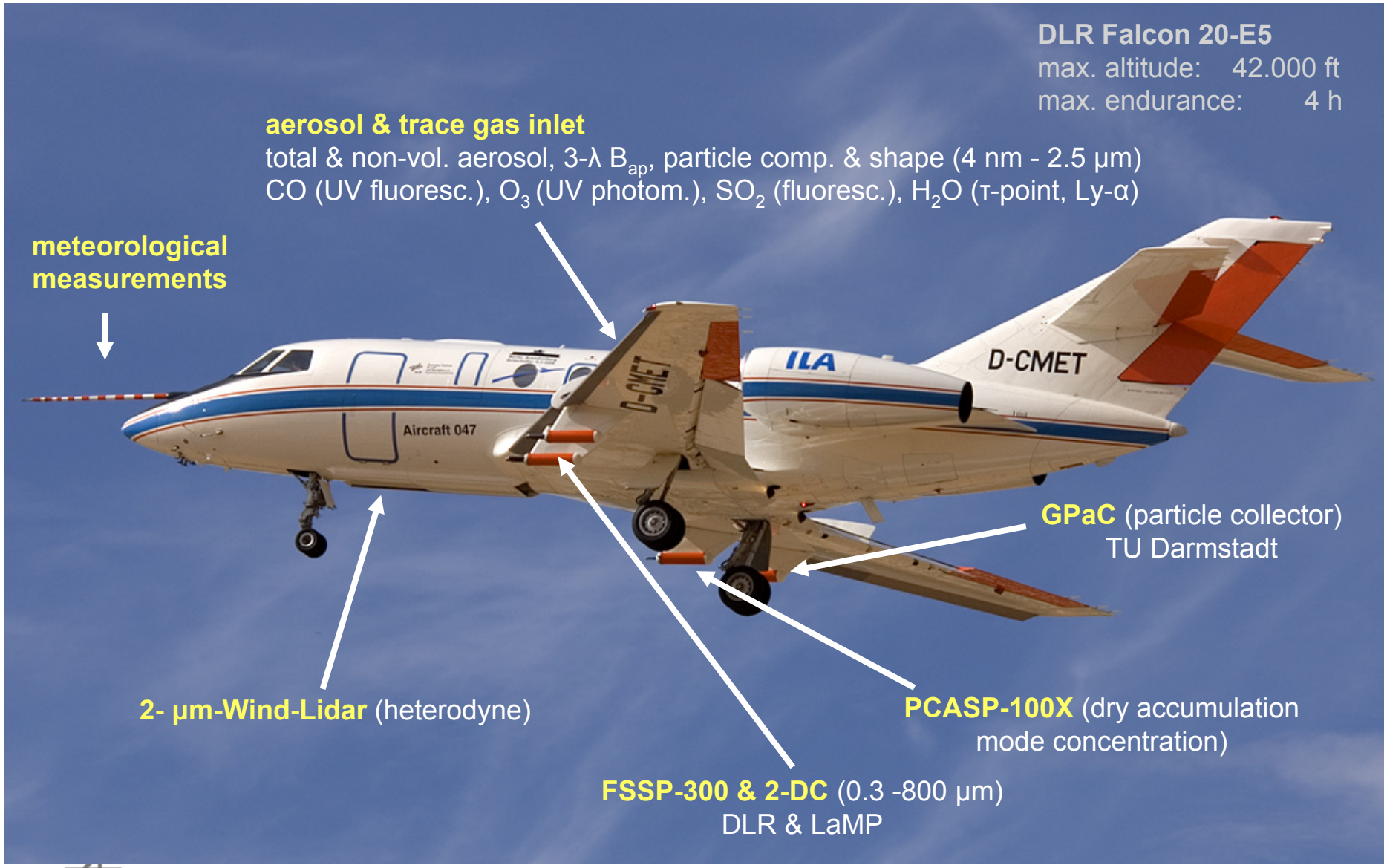
taken from BBC: Iceland volcano in maps

Objectives: Operational & scientific

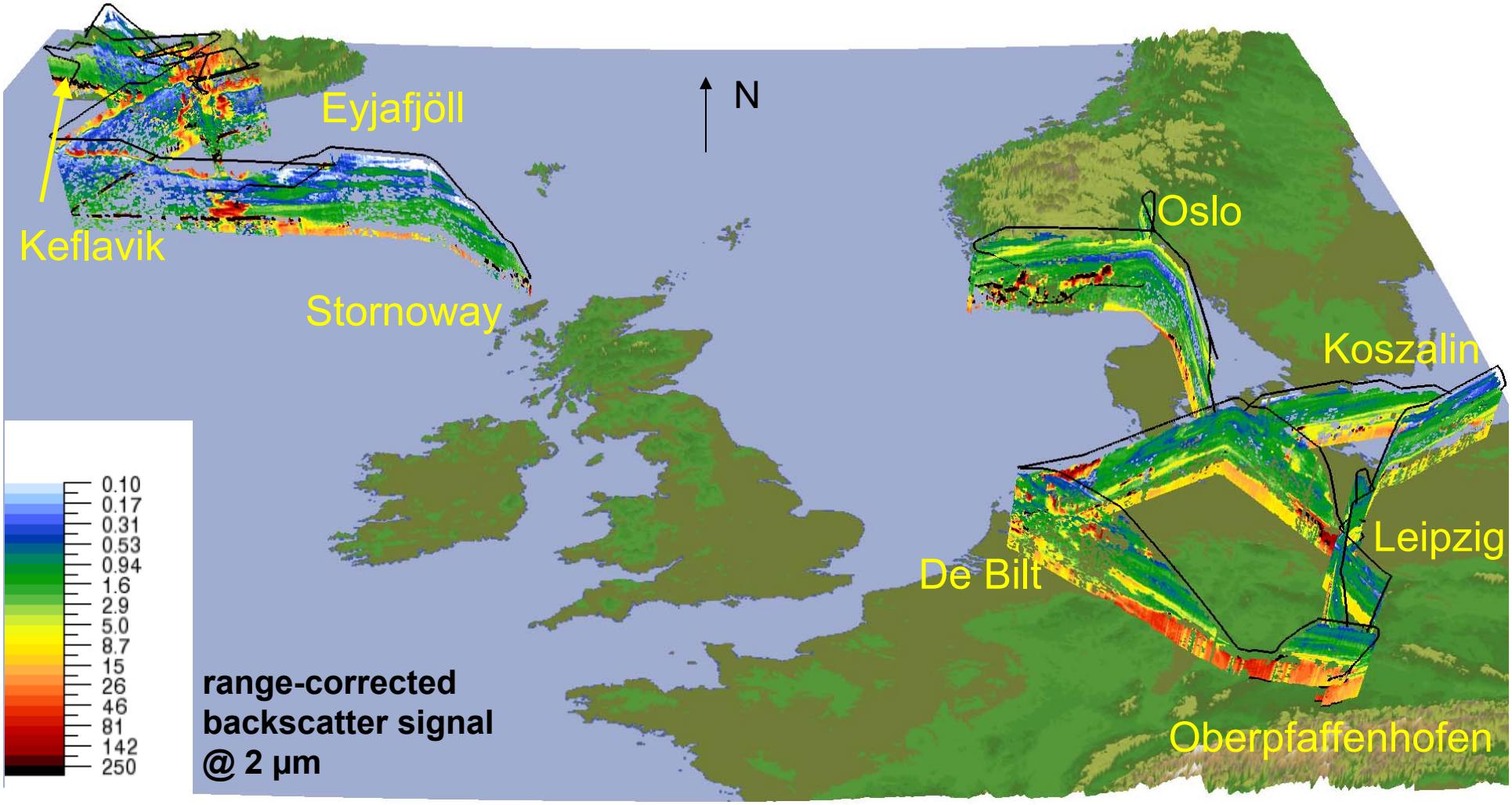
- Closure of airspace justified or exaggerated?
- Quality of forecasts?
- Comparable to Saharan dust?
- What do the lidar instruments see?
- How to convert particle number concentrations to mass concentration?

- Aviation conditions near Iceland
- Volcanic source (mass, particle sizes, chemistry)
- Chemical composition
- Volcanic dynamics

Falcon 20E D-CMET, DLR Oberpfaffenhofen, since 1976



Nine DLR Falcon flights, April 19 - May 2: OP - Iceland



OP –Keflavik: 2700 km

(perspective plots generated by Martin Wirth, DLR, IPA)

Vulcanic ash layer over Leipzig, April 19, 2010, 15:00 UTC

Lagrangian: Iceland - North Atlantic - Ireland - Scotland

(29/04/2010: 50 km distance, arriving in Iceland)

01/05/2010: (8-)200 km distance, 62.5 N, 16.5 W, 11:44 UTC, 1-5 km altitude (age < 3.7 h)

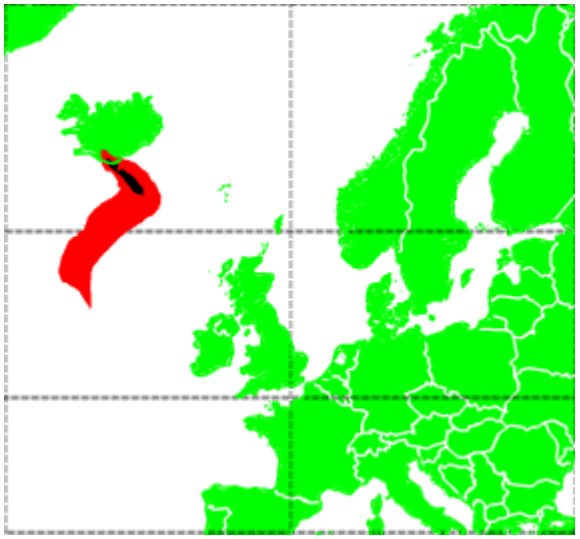
02/05/2010: 450 km distance, 15 W, 60 N, 15:00 UTC, May 2, 2010, age 7 h

04/05/2010: Mace Head, W, N, ? UTC, May 4, 2010, age about 60 h

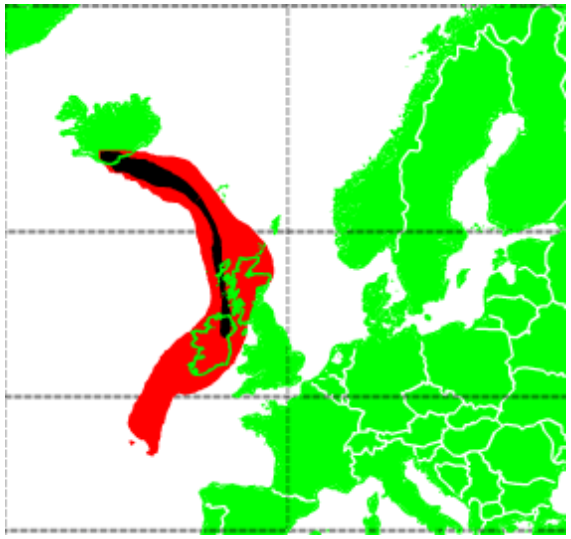
05/05/2010: ARSF and FAAM (U Manchester), Scotland airborne, age about 80 h

1800 UTC **29/4**

18001200 UTC **01/05**



0600 URC **04/05**/2010



Modelled Ash Concentration from FL000 to FL200 at 1800 UTC 29/04/2010

This is a guidance product, supplemental to the official VAAC London Volcanic Ash Advisory and Volcanic Ash Graphic products.
Issue time: 201004290000

Predicted area where volcanic ash may be encountered

Predicted area of ash concentrations that exceed acceptable engine manufacturer tolerance levels

Eyjafjallajökull volcano plume, 29 April, late afternoon time

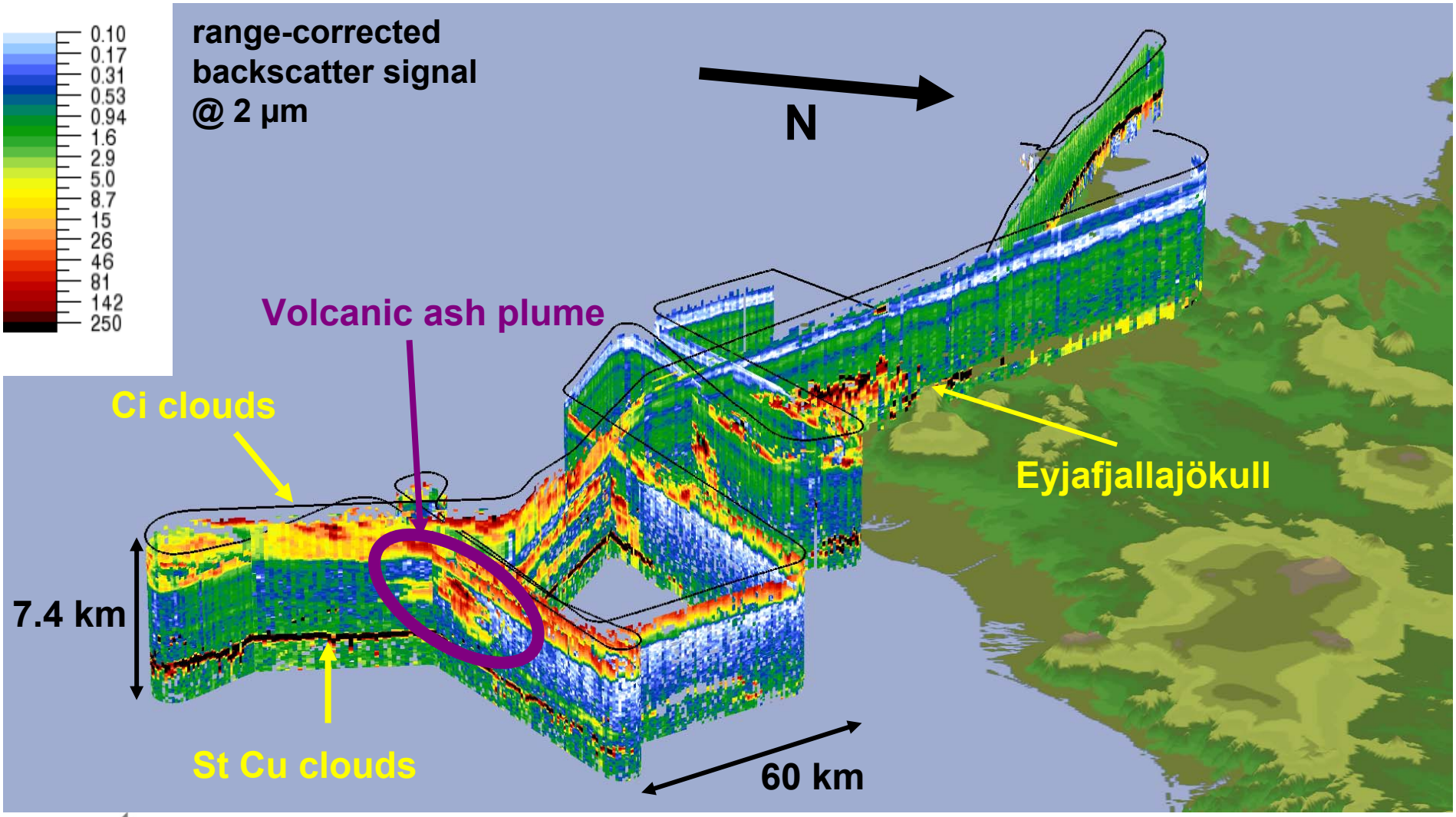
Eyjafjallajökull volcano plume, May 1, noon time

Eyjafjallajökull volcano plume, May 1, noon time

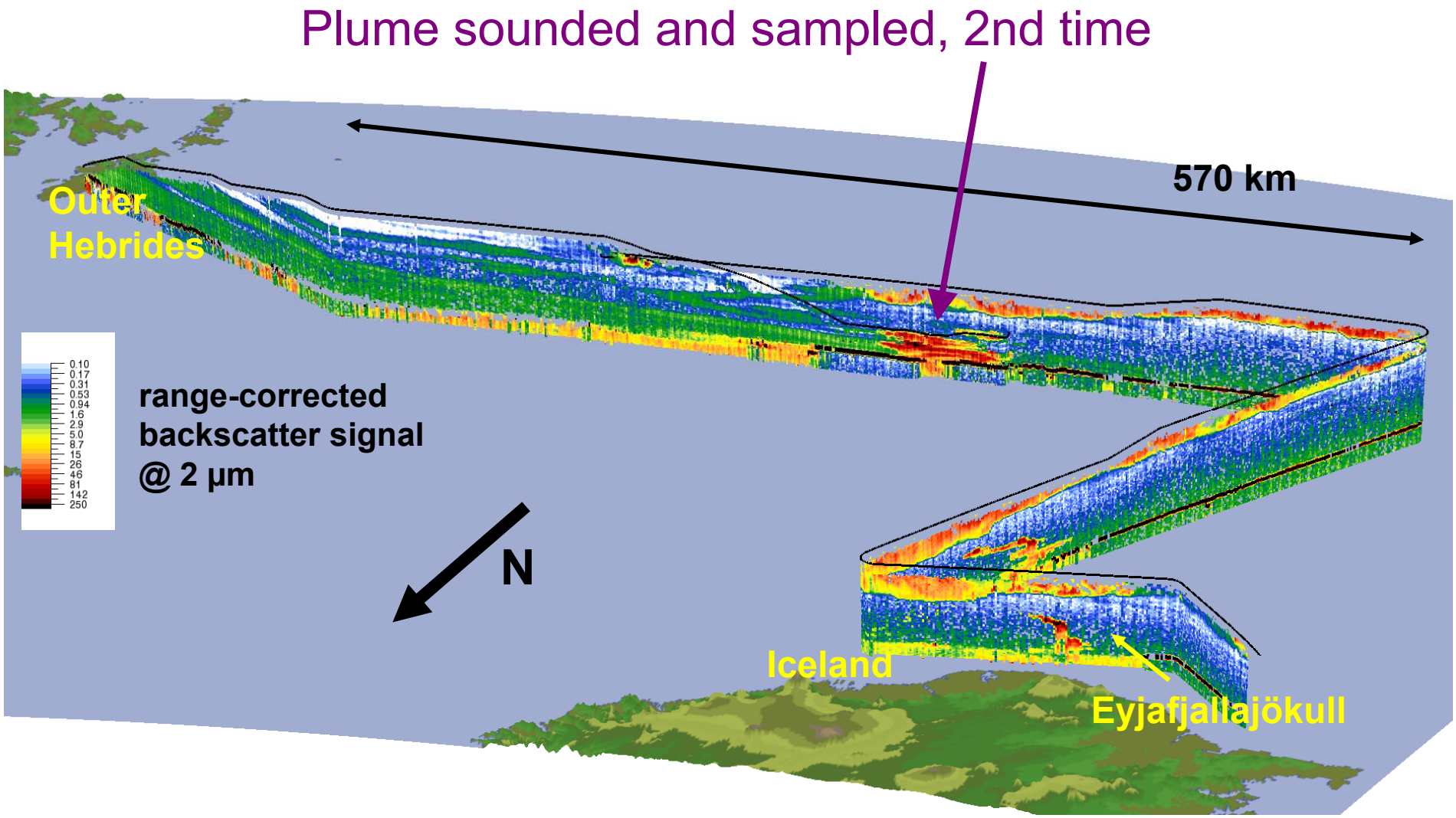
Reykjavk/Keflavik: No plume traces, May 1, noon time

Plume and Keflavik (Iceland) soundings, May 1

plume sounded 1st time

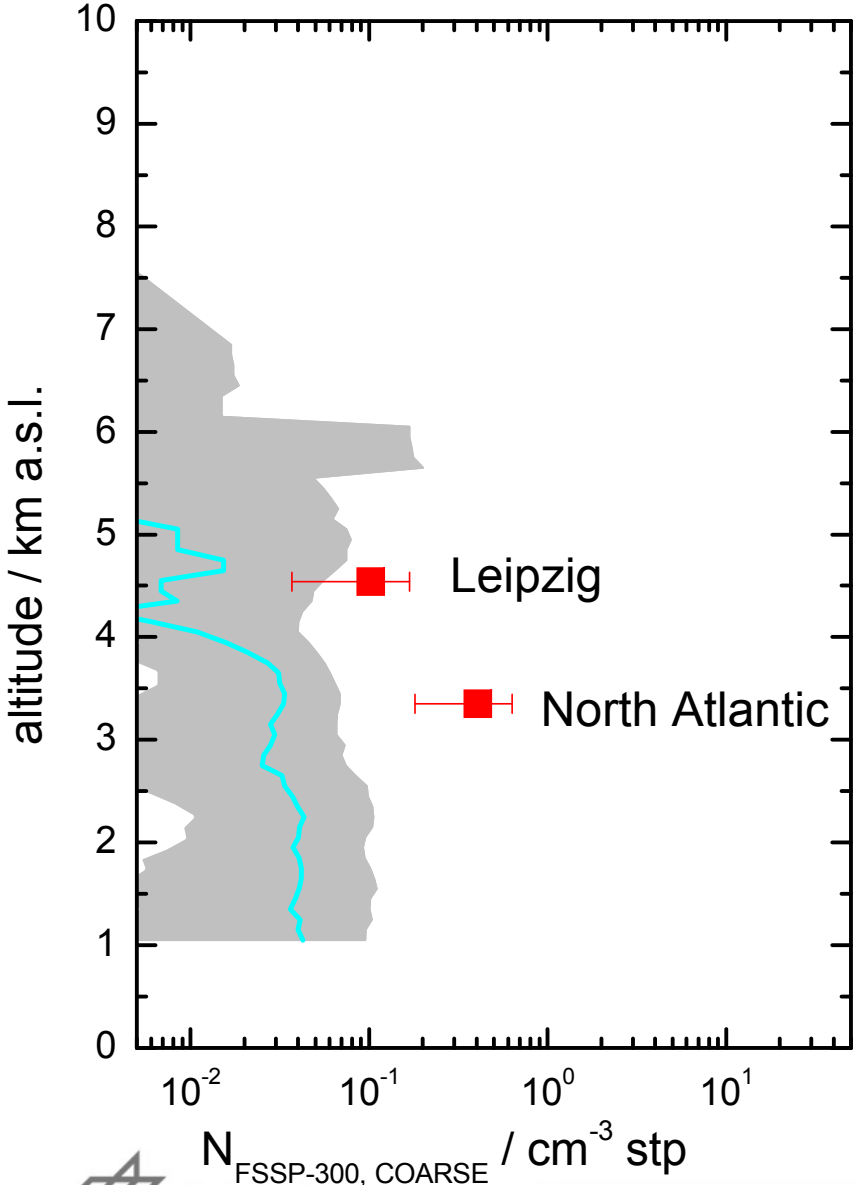


From Keflavik to Stornoway, May 2



North Atlantic (60° N): 15 minutes before flying into the plume

Comparison with Saharan dust (SAMUM-1, 2006, 17 flights)



Aerosol-optical depth (AOD, @532)

Munich

17.04. (plume age: 3 days): 0.8

19.04. (plume age: 5 days): 0.4

Leipzig

17.04. (plume age: 3 days): 1.0

19.04. (plume age: 5 days): 0.5

For comparison:

Sahara, SAMUM-1: 0.4 - 0.6

Conclusions (science & operations)

- Falcon measurements between April 19 and May 3, 2010: 2- μm-Lidar, in-situ aerosols, CO, O_3, SO_2, H_2O
- Particles sizes 10 nm - 30 μm age dependent (mainly silicate, ammonia sulfate, more Na, K than in Saharan dust),
- Mass loading (60 μg/m^3, Leipzig, 5 days) comparable to Saharan dust (< 0.2 mg/m^3)
- 200 km distance, 3-4 h age: 40 km wide, 2 km thick, 15 m/s, sharply edged, strong wet convective turbulence, well mixed?
- 450 km distance (same plume), 7 h age: at upper plume edge: 400- 3400 μg/m^3, no 2-DC probe particles, mass flux > 3000 kg/s, strong chemistry
- Lidar signal and FSSP-300 signal strongly dependent on refractive index, ash density, particle size spectrum 1- 50 μm

- Mid-European airspace closure justified until Sat. April 17; then ageing of ash load
- Keflavik/Iceland free of ash as predicted on April 19 - May 2
- Quality of forecasts reliable enough for aviation
- Future: Combination of models + lidar + satellite + in-situ
- Improved linking between operations and academia
- Continue operations of the DLR Falcon as Emergency Aircraft

DLR Deutsches Zentrum für Luft- und Raumfahrt e.V. in der Helmholtz-Gemeinschaft